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Thin Silicon MEMS Contact-Stress Sensor

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THIN SILICON MEMS CONTACT-STRESS SENSOR

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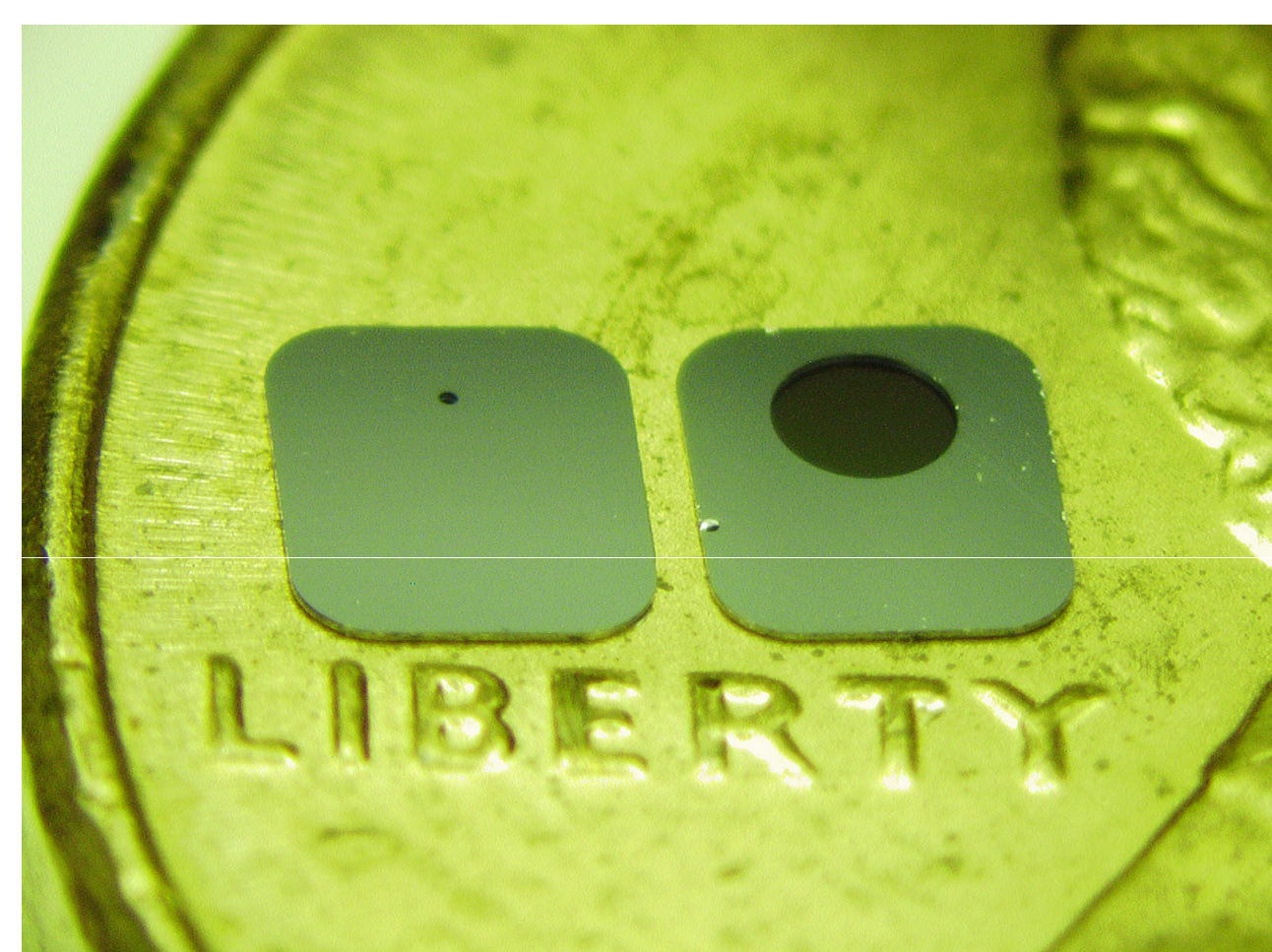
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This thin, MEMS contact-stress sensor continuously and accurately measures time-varying, solid interface loads over tens of thousands of load cycles. The contact-stress sensor is extremely thin (150 μ m) and has a linear output with an accuracy of $\pm 1.5\%$ FSO.

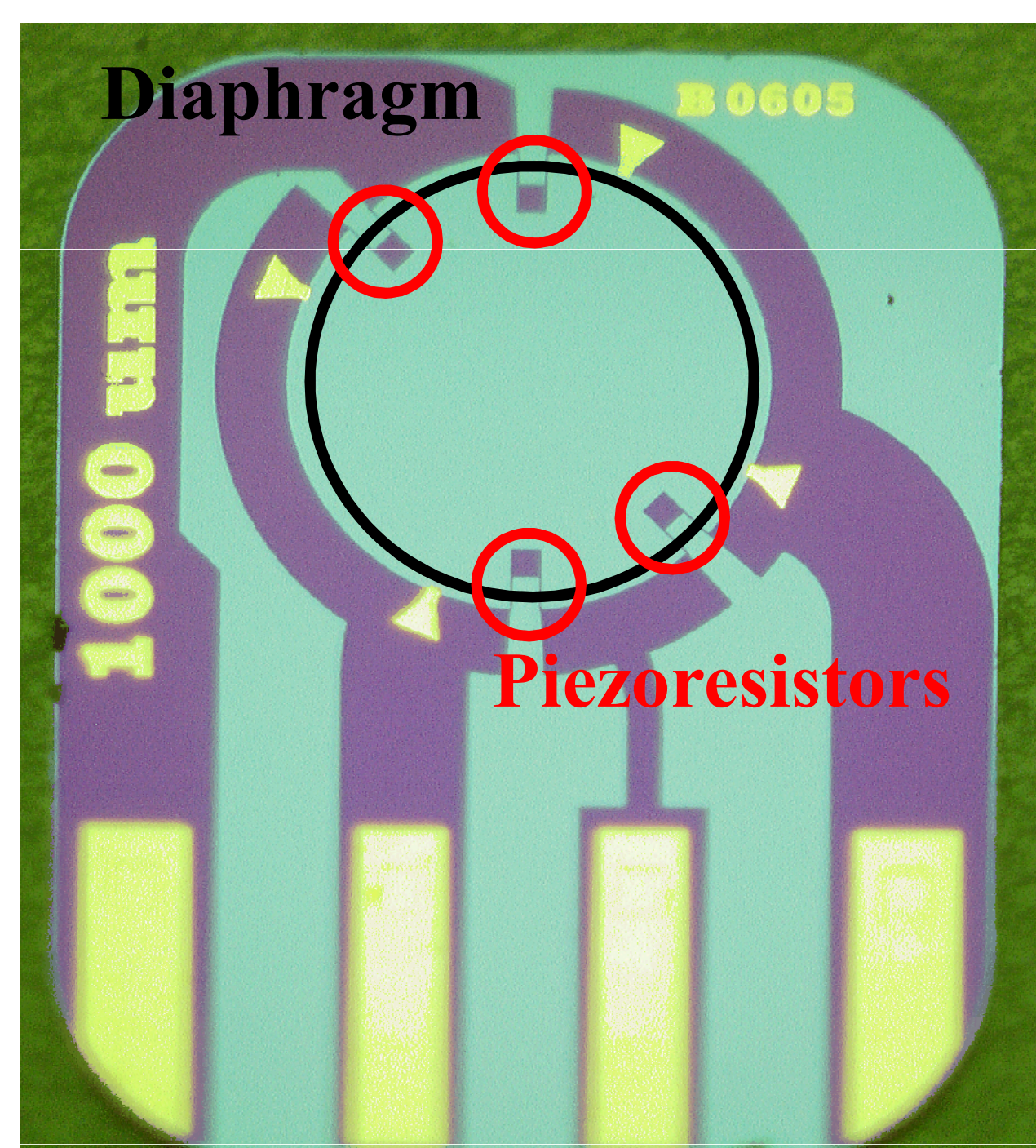
Silicon MEMS Contact-Stress Sensor



Front-Side
(500 μ m-radius Diaphragm)



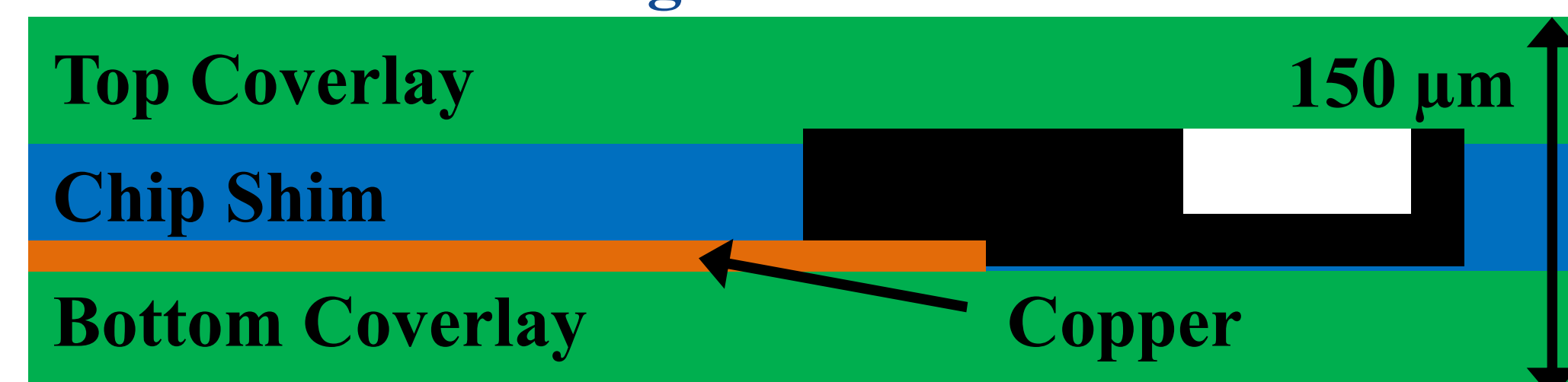
Back-Side (Etched Diaphragms)
(50 μ m-radius, left, and 500 μ m-radius, right)



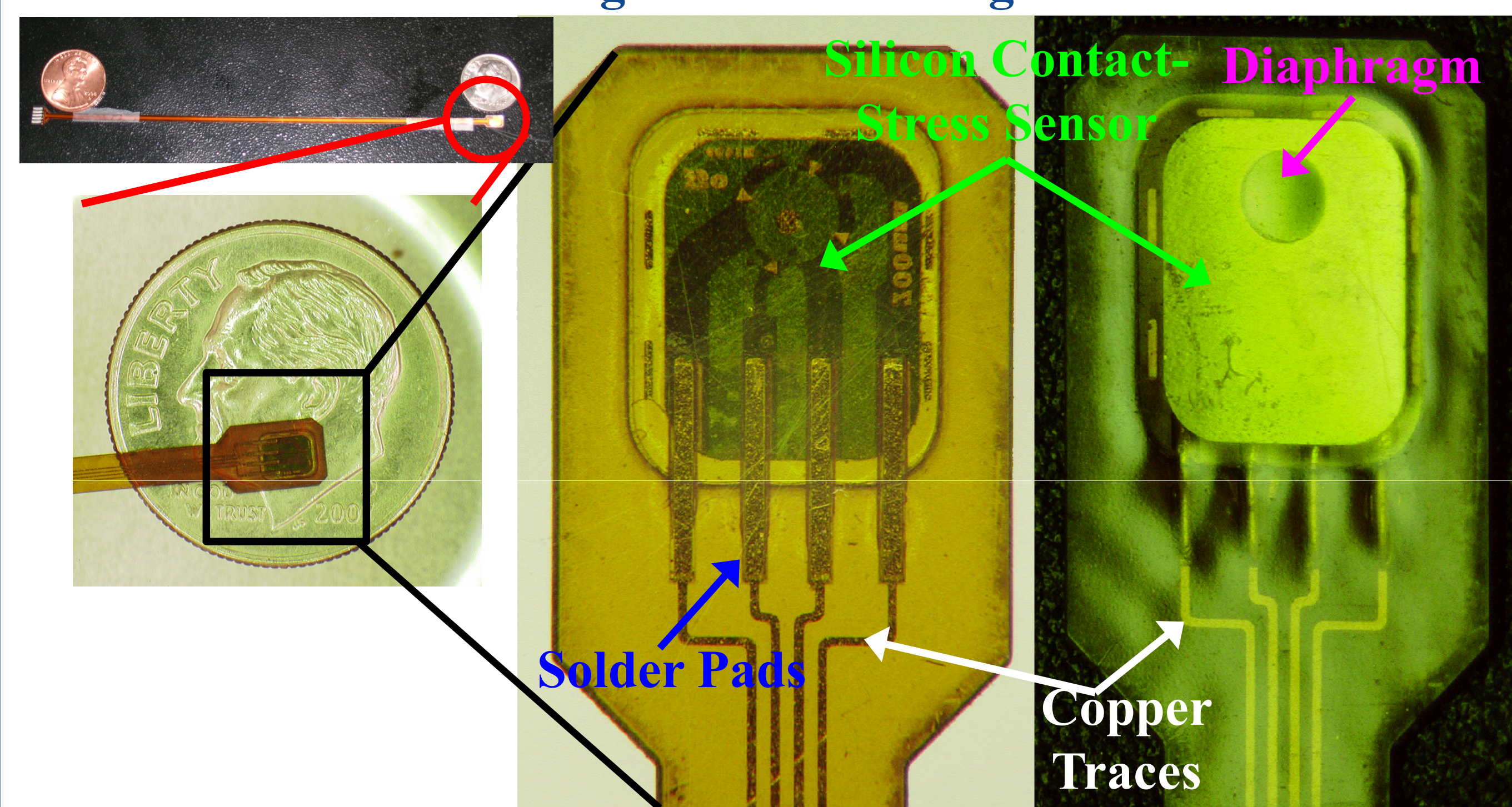
- Silicon Sensor Dimensions
 - 2mm x 2.5mm
 - Thickness: 50–65 μ m
- Load-Sensitive Diaphragm
 - Thickness: 0.5–25 μ m
 - Radius: 50–500 μ m
- Piezoresistors arranged in a Full Wheatstone Bridge
- Temperature-compensated
- Drift-Free

Packaged Contact-Stress Sensor

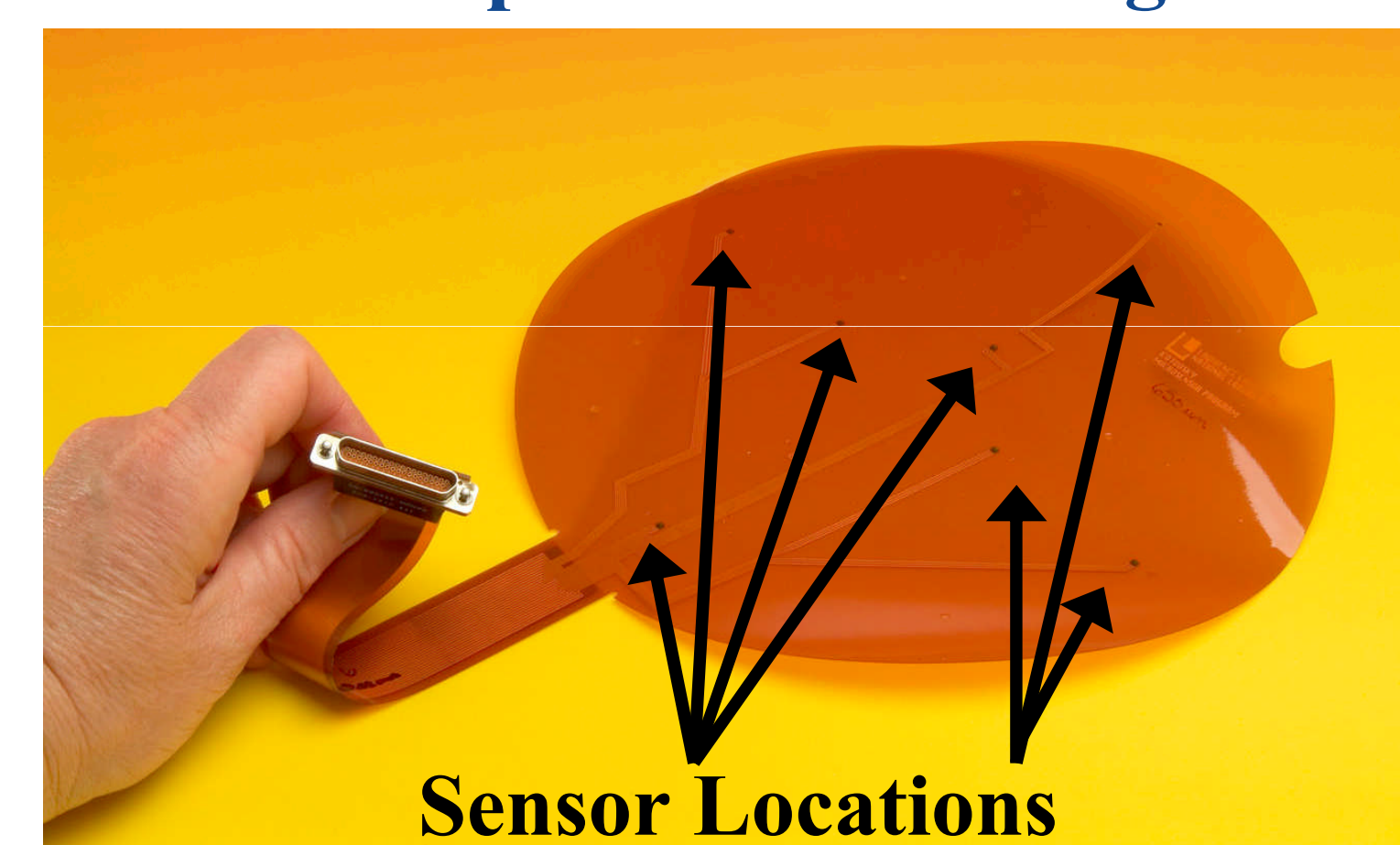
Package Cross-Section



Single-Sensor Package



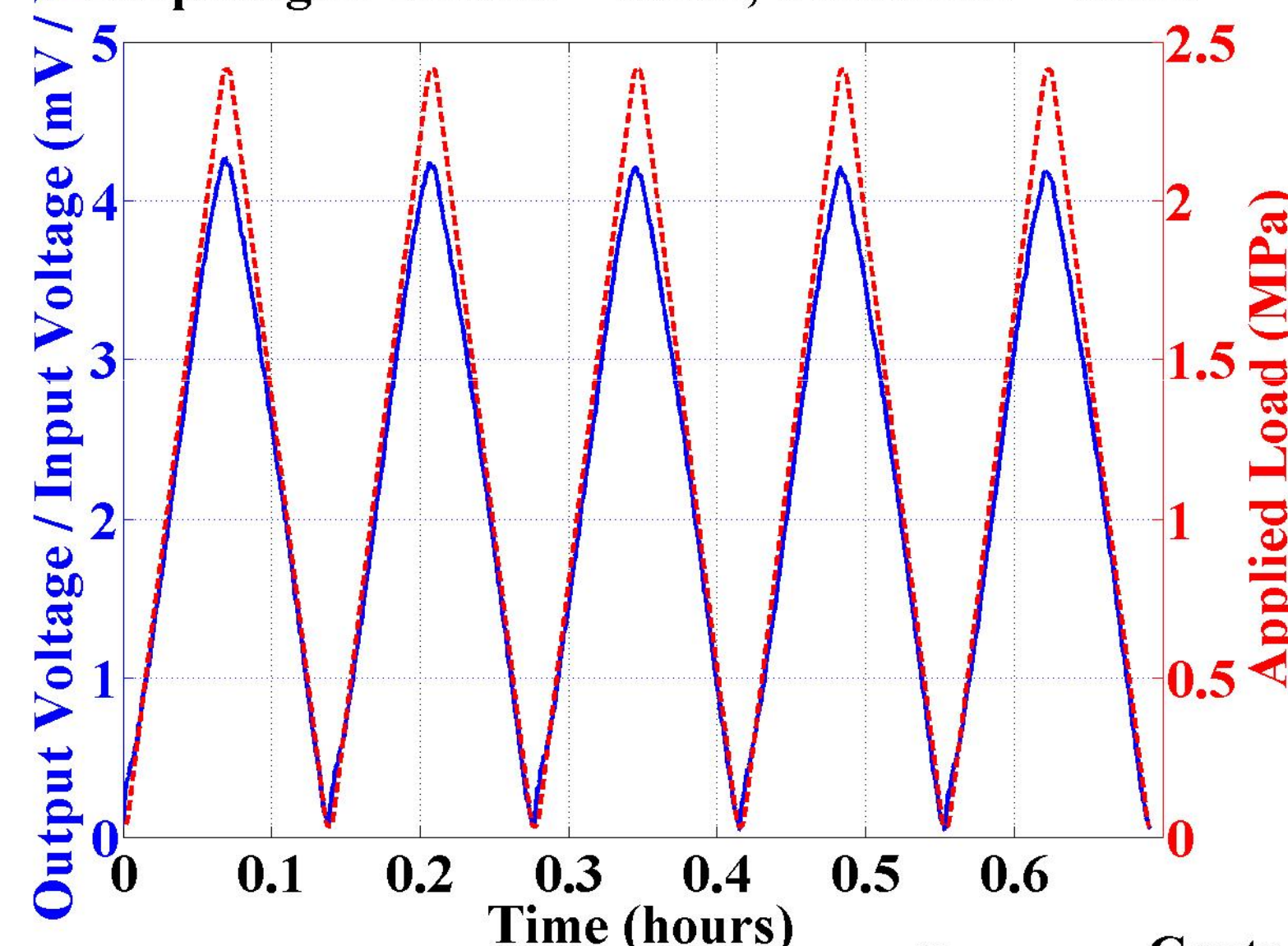
Multiple Sensor Package



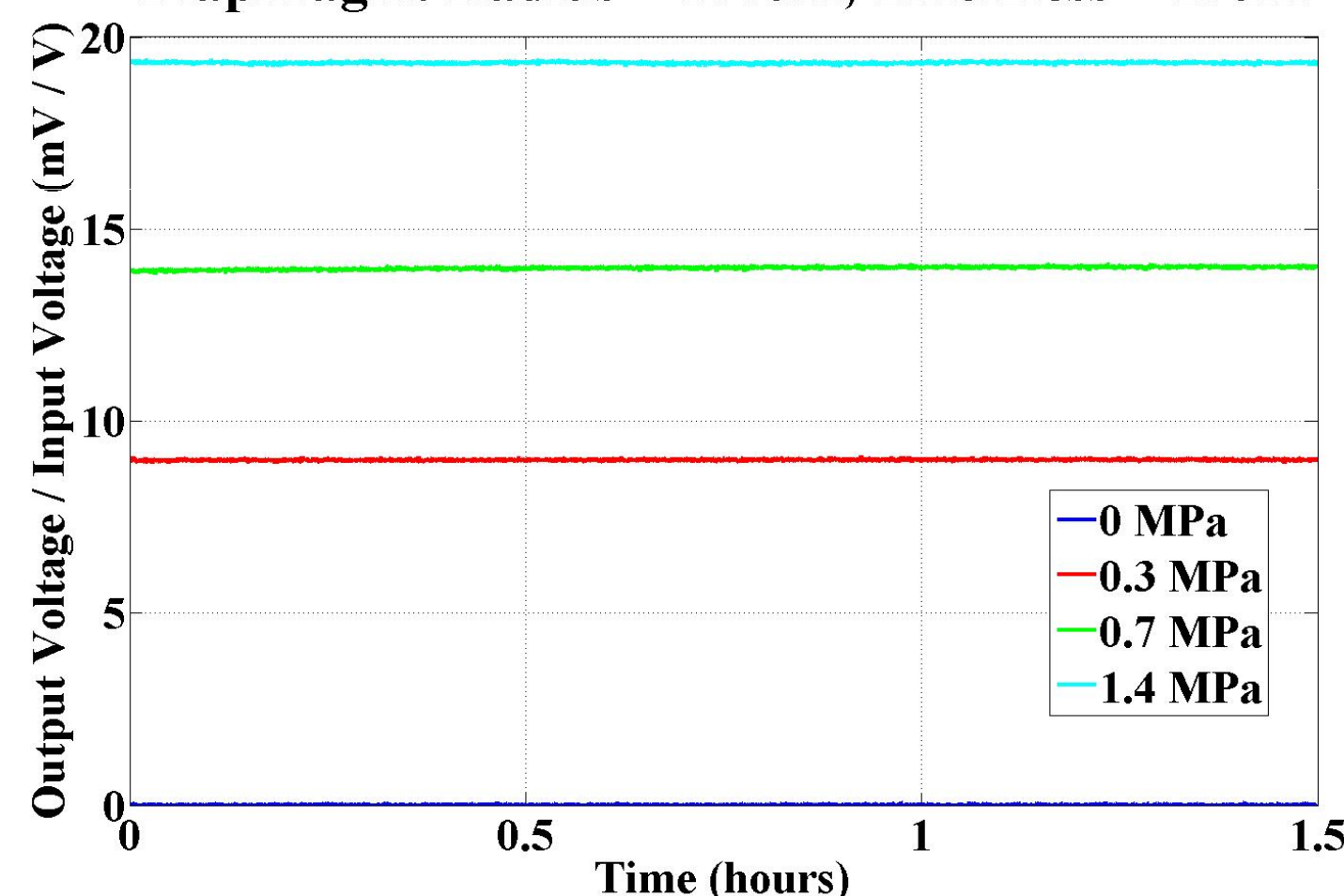
Flexible polyimide fully encapsulates silicon sensor, accommodating curved surfaces

Contact-Stress Sensor Testing Results

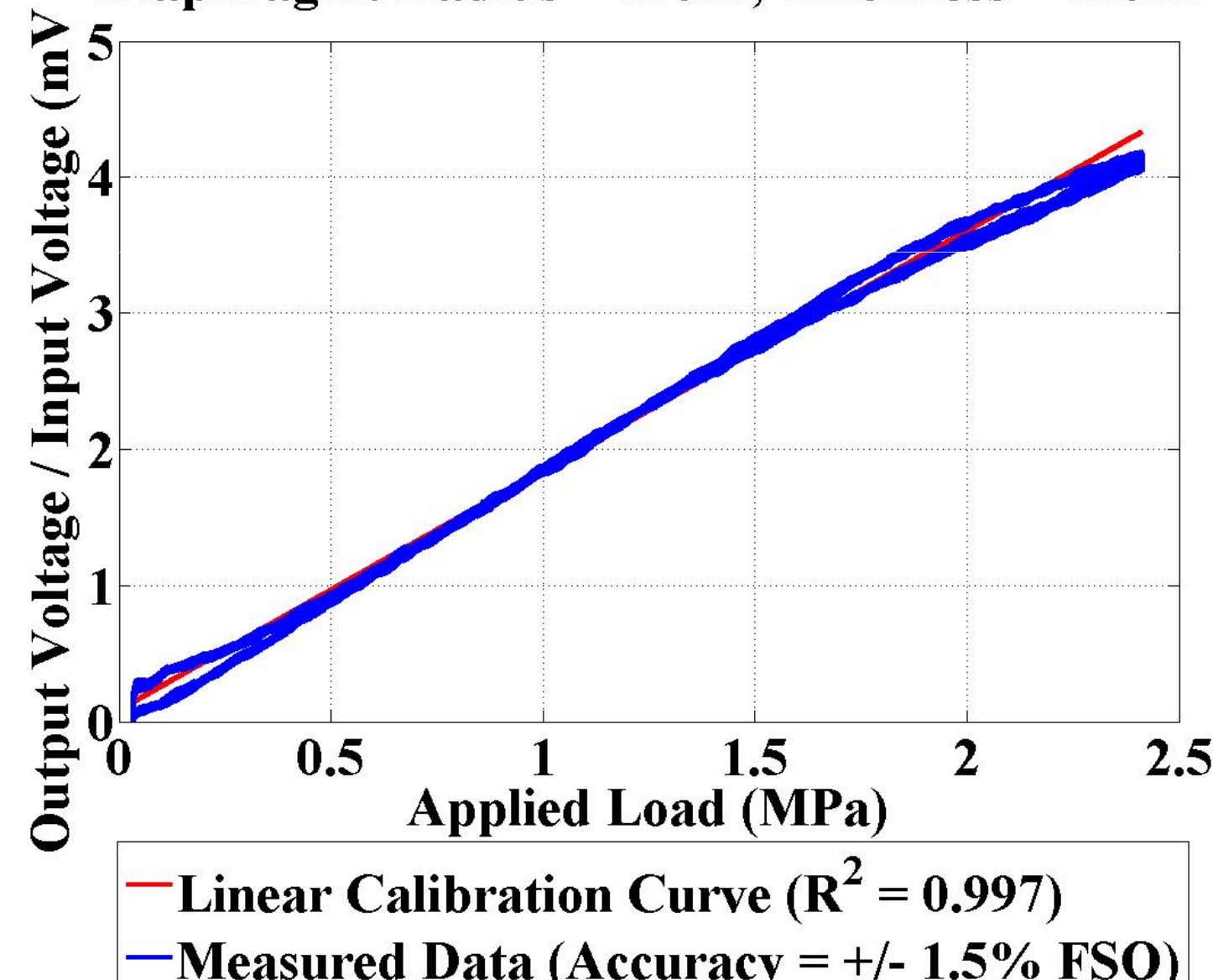
Contact-Stress Sensor Output for Time-Varying Load
Diaphragm: Radius = 50 μ m, Thickness = 15 μ m



Contact-Stress Sensor Drift for Different Static Loads
Diaphragm: Radius = 100 μ m, Thickness = 15 μ m



Contact-Stress Sensor Accuracy
Diaphragm: Radius = 50 μ m, Thickness = 15 μ m



Typical Contact-Stress Sensor Performance

Electrical/Mechanical Drift	$< \pm 0.8\%$ FSO
Absolute Accuracy	$\pm 7.0\%$ FSO
Average Accuracy	$\pm 1.5\%$ FSO
Hysteresis	$\pm 6.5\%$ FSO
Load Range Tested	7kPa – 4MPa
Calibration Curves	$R^2 > 0.99$

FSO = Full-Scale Output